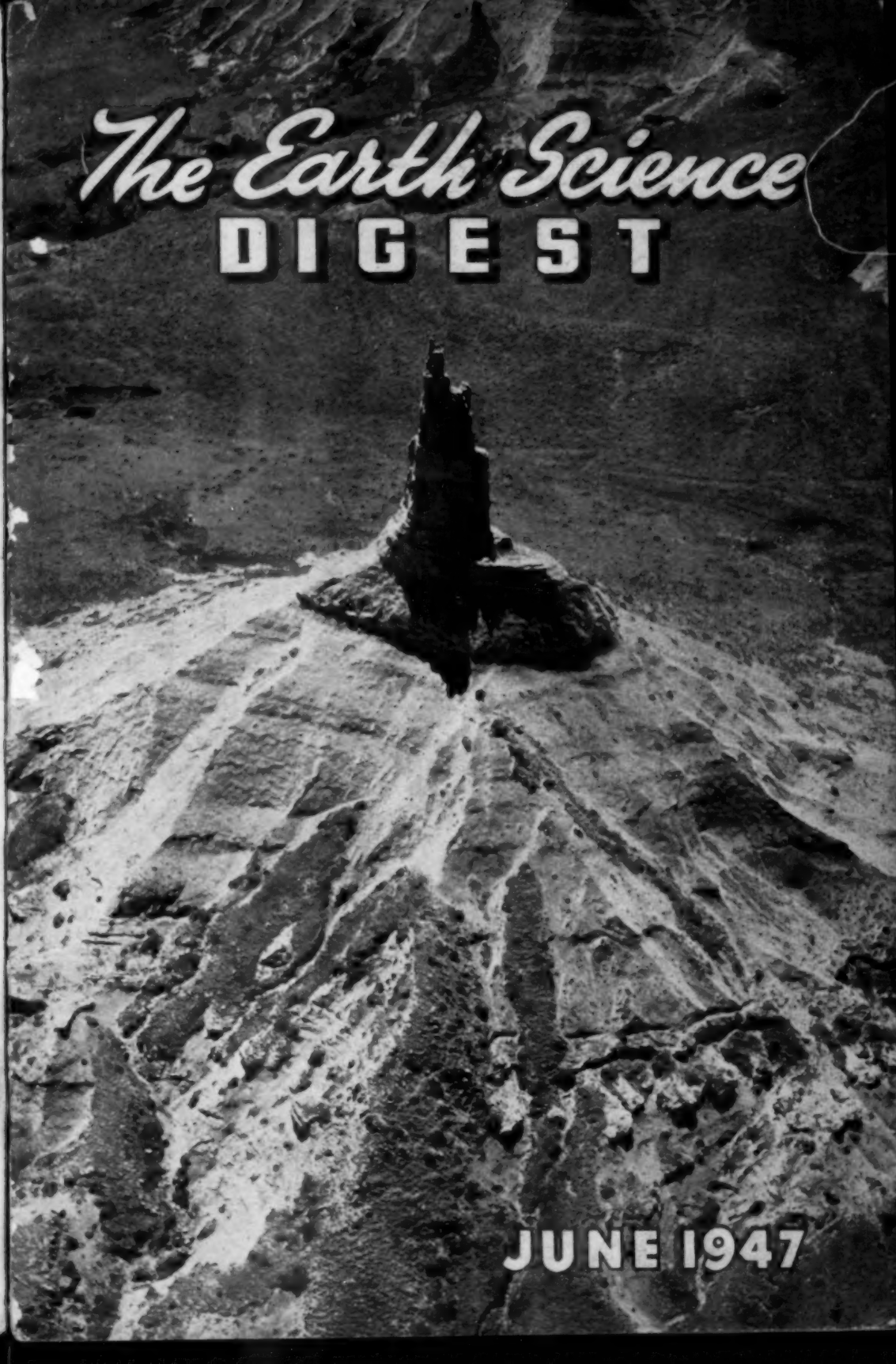
The Earth Science
DIGEST
JUNE 1947

The Earth Science Digest

Box 57  Omaha 3, Nebraska

Published monthly by
The Earth Science Publishing Co.

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SUBSCRIPTIONS

Per copy	**$ .25**
1 year	**2.00**
2 years	**3.75**
3 years	**5.00**

Advertising rate card will be sent upon request.

Vol. I June - 1947 No. 11

Contents

Asbestos quarry, showing large power shovel in the background. Quarry located at Eden, Vermont. (Courtesy U. S. Bureau of Mines).

Asbestos – The Miracle Mineral

Eugene W. Nelson

There's a rock with more "believe-it-or-not" properties than many of the most famous metals have. For instance, steel seems to be just about tops as far as strength goes, yet in a few years time rust can completely destroy a large steel structure. This rock, however, has lain buried in the earth ever since that long-gone day when it was created, yet it is still absolutely unaffected by the forces of decay and disintegration that work such havoc with wood and metal.

This rock is asbestos. It is the only mineral in the world which—in its natural state—can be carded, spun, and woven into cloth. So, since asbestos is older than anything in the animal or vegetable kingdom—and therefore older than wool, silk, cotton, or flax—asbestos is the oldest fiber in existence!

The pecular properties of the yarn and cloth woven from this world's oldest fiber have been known and appreciated for hundreds of years. In spite of that, however, asbestos did not really come into its own until the past half-century when industrial scientists re-discovered its truly magic properties and put them to work for us on a truly colossal scale. In fact, industrialists have been so hard at work on asbestos during the past fifty years that in just that short span of time they have found more uses for this rock

than for almost any other one material.

Many of the ancient races knew how to weave cloth from asbestos. Much of this fire-proof cloth they used in making the "sacred lamp wicks" that burned "eternally" in the temples and on the altars of dozens of different pagan g o d s. The lamps themselves were fed continually with fuel from hidden containers. Since the asbestos wicks were not consumed by the fire, the lamps were thus a b l e to maintain their "eternal" flame without having their wicks trimmed and renewed as ordinary lamps did. Of course, these "gadgets" greatly mystified the not-too-bright common people who worshipped in the temples and greatly increased the authority of the priests. Small wonder, then, that asbestos was considered to be a magic substance in those times!

The Greeks also knew the wonderful, fire-resistant properties of asbestos cloth. As long ago as 500 B. C., the Greeks were using asbestos cloth as a "funeral shroud" for their dead kings. That is, when any one of the many Greek kings died or was killed in battle or by an assassin, his body was wrapped in this "cloth of stone", cremated, and the ashes removed. The precious shroud was then returned to its hiding place and was carefully guarded until another king died.

There i s a legend which could easily be true which tells us how Charlemagne once prevented going to war against the Emperor of the East — Harun-al-Rashid — by taking advantage of the peculiar properties of asbestos cloth.

To Charlemagne's court one time came messengers from Harun-al-Rashid. Their task was to discuss matters of grave political import between the greatest of the Christian kings and the leader of the ever-expanding Mohammedan empire. It was a tiresome discussion inasmuch as a single word spoken in anger by any one of t h e Franks or Arabs could have plunged the two powers into a disastrous war.

Finally, to ease the growing tension, Charlemagne ordered a feast to be spread so all could relax. After the banquet was finally ended, Charlemagne's servitors took his beautiful white table c l o t h — now blotched with wine and grease — and hurled it into the huge fireplace where a lusty fire was roaring. The Saracen envoys, accustomed to the extravagances of monarchs, looked on in polite amusement but refused to be impressed.

But when that table cloth was removed f r o m the fire, *whole and clean*, the envoys muttered prayers into their beards and showed every visible indication of being much impressed indeed with Charlemagne's magical prowess. They also lost all their former war-like ardor and began to talk about peace. And so Charlemagne's asbestos table cloth probably s a v e d Europe from a bloody invasion by the Saracens.

Despite all the use that the ancients made of asbestos, however, it is clear that the ancient scientists did not know what asbestos really is. That learned Roman — Pliny the Elder, who wrote on all manner of natural history subjects — declared that asbestos fiber was obtained from a flower! This flower, he added in his book, grew in a desert land and so was able to resist the heat from man-made fires. In those early times, asbestos cloth was often referred to as "magic flax", and the mineral itself was commonly known as "cotton stone".

With the fall of Rome and the coming of the Dark Ages, knowledge of asbestos seems to have been pretty well lost in Europe. Marco Polo, however, heard about asbestos cloth on his wanderings. It was while the globe-trotting Italian was in Tartary that the natives showed h i m

Nature's most remarkable inorganic creation — asbestos. As found in the natural rock, asbestos is dense and heavy and usually has the aspect of stone. When the silky fibers are opened up, the best grades break down into a mass of delicate, interlacing, light-colored threads which — because of their remarkable chemical and physical properties — have become indispensable to civilization. (Courtesy Johns-Manville).

some cloth that would not burn. They told Marco that they cut the skins from "salamanders" — salamanders were supposed to be the spirits of fires and to live only in the hottest flames — slit the skins into strips, and wove them into cloth. But Marco had seen asbestos lamp wicks and heard about asbestos shrouds. So he poked about and made a nuisance of himself with his questions about this "salamander skin" until the Tartars finally admitted that the cloth was really made from "fibers not unlike wool, which men dig from a mountain".

Today, of course, we know that asbestos is merely a mineral, just as granite and limestone are. The rock as found in quarries, is dense and heavy. Chemically, most varieties of asbestos are hydrous complex silicates. The fire-resisting property of asbestos cloth comes mainly from the silica in its makeup.

Physically, the most important quality of asbestos is its fibrous, crystalline structure. Among all of the other minerals in the world which nature has built up out of analogous elements, not one of them has such a fibrous, flax-like structure as asbestos. When a piece of asbestos—which is often dark-colored and with the general aspect of stone — is picked apart or "teased up", it breaks down into a mass of delicate, interlacing light-colored threads.

These threads closely resemble silk fibers. No other mineral has these soft, dainty fibers except asbestos.

When you look at what appears to be a single strand of "teased up" asbestos under a powerful micro scope, the smallest fiber that you can distinguish will exhibit a "brushing out" at its ends. This evidence of a still further parting of the "single" strand into finer and ever finer fibers.

There are two distinct types of asbestos, each sharply differentiated both chemically and mineralogically. These are known as Serpentine (more commonly referred to as Chrysotile), and Hornblende (also known as Amphibole). Hornblende is of little commercial value when compared with Chrysotile since the former type does not possess the tensile strength; the flexibility; and the great resistance to acids which distinguishes Chrysotile. For this reason, only asbestos of the Chrysotile variety will be considered in this article.

According to the theory of its origin now most generally accepted, olivin rock (a ferrous silicate of magnesium which frequently occurs as a mixture of basaltic eruptive stone) was transformed by volcanic action into colloidal form. This action caused the material to swell and push back the surrounding rock. Shrinkage took place later, causing cracks and crevices to appear. Then by a process of metamorphosis — and a million years was a short span of time during this process — the rock was transformed into the remarkable, fibrous substance known as asbestos which grew very slowly into these crevices.

There are little pockets of asbestos scattered widely all over the world. If you tried to locate them on a globe, you'd have to do a lot of spinning before you found all of them! Asbestos is found in Venezuela, Rhodesia, New Zealand, Ireland, Japan, Germany, Hungary, China, Australia, the United States, South Africa, Russia, Turkey, Cyprus, Finland, and France. However, the great mines in the Quebec area of Canada supply twice as much of the asbestos used by industry as do all the rest of the world's mines put together.

Canadian asbestos is considered as standard for the entire asbestos industry, not only because of its abundance but also because of the uniformity of its external structural form and of its internal composition. All asbestos is compared to Canadian asbestos to determine its quality in any respect, since the Canadian product offers an astonishing uniformity in chemical composition and its tensile strength, elasticity, clevability, and suppleness are greater than in any other extensively mined variety of this mineral. The Canadian mines alone have yielded as much as 100,000 tons of asbestos in a single year, and the remaining supply seems practically inexhaustible.

Queerly enough, althrough asbestos was so widely known in ancient times and was re-discovered by Marco Polo, the modern world paid little attention to it until quite recently. In fact, it was not until 1872 that this fibrous rock began to be appreciated all over again.

It was in 1872 that a shrewd New York merchant acquired some asbestos mines in Italy. This merchant ordered a pair of asbestos gloves to be woven and shipped to him. With them, he put on a promotional campaign as clever as anything ever staged by professional Hollywood press agents.

Everyday when this man's hardware shop was filled with customers, the merchant would give his assistant the "highsign". The helper then would make a great to-do about slipping on a pair of white gloves. Then he would open the door of the base burner and from the roaring fire scoop out a double handful of

glowing coals. After admiring them a bit, he would toss the coals back into the stove and pass the unharmed gloves around for the customers to gape at.

This experiment, which in time drew large throngs of unbelievers, created such an interest in the magic mineral that the hardware merchant — his name was H. W. Johns — was soon forced to find supplies of asbestos in America. It was Johns who eventually uncovered the vast Canadian deposits and in so doing, laid the cornerstone for the almost fabulously-great Johns-Manville asbestos empire.

In those early pioneering days, asbestos was mined and sorted entirely by hand. Things are vastly different today, in the Canadian mines, at least. Today, the quarry pit at Asbestos measures more than 4,000 feet across and its floor is more than 350 feet below the level of the old hill top.

To get at the asbestos in this pit, electric shovels strip the covering of soil from the rock. Holes are then drilled in the rock face, loaded with explosive, and detonated. The primary blasts move the face of the rock, and secondary blasts still further divide the larger masses.

Next, the big power shovels begin the process of sorting and loading the asbestos rock. Shovel operators and supervisors decide which is waste rock for disposal on the dumps and select the grades of ore desired for milling. A crew of "cobbers" is employed to pick the conspicuous long fibers by hand from the shattered rock. This "crude" needs no further processing except cleaning and screening in the cobbing shed to make it ready for spinning.

The remainder of the asbestos-bearing rock is carried up from the mine in railroad cars and enters the primary crushers at the mills, where it is crunched into pieces between two and three inches in diameter. This rock passes through a battery of driers designed to remove moisture from the ore, and then it again goes through a crusher. After this, it is ready for the milling process in which the asbestos fiber is extracted.

It is claimed that of sixteen tons of rock in the workings, five tons are immediately discarded as worthless, while eleven tons go to the mills. In the mill, one ton of useful asbestos fiber is extracted from the eleven.

To mill out this ton of fiber, the rock is passed through a series of crushing and fiberizing stages. After each stage, a collector, which operates on the principle of an exhaust fan, picks up the liberated fiber. The first fibers collected are the "spinning fibers" — the best best grade of milled asbestos and second in quality only to the hand-

Molded asbestos shingles, used by the millions for fireproofing and beautifying modern homes. (Courtesy Johns-Manville).

picked "crude". The next grade is used in the manufacture of high grade insulations. Then comes the fiber used in the manufacture of asbestos shingles. Each grade is especially adapted to certain specific purposes, even down to the shortest fibers which are useful in many products.

During the years, research workers have compiled a vast amount of scientific information about the properties of asbestos. Particular atten-

Mining asbestos at one of the Johns-Manville quarries in Canada. (Courtesy Johns-Manville).

tion has been paid to the fact that this "cloth-of-stone" will not conduct electricity and will resist extremely high heat. Using all the data gathered by science, industrialists have been better able to put asbestos to work for us in countless ways.

Today, asbestos rope, twine, paper, and building board are now produced in enormous amounts each year. In the electrical industry, asbestos products serve switchboards and control panels. Asbestos insulation helps to conserve heat in huge boilers and steam lines. Safety on modern highways and in the city streets is due in large part to the tough, heat-resisting asbestos brake linings in trucks and cars. Fireproof asbestos roofing and shingles not only protect but beautify our homes. In the refining of petroleum and in the manufacture of steel, glass, cement, food, and many other products, asbestos cloth and asbestos shields protect the workmen from the withering heat needed, and also saves money by its insulating properties.

It may seem queer that such an ancient and valuable fiber as asbestos has not been more widely used as a textile material. The main reason is the extreme shortness of most of the asbestos fibers. Coarse asbestos yarns, using the scarce long fibers, have been spun industrially for fifty years. Materials made from such cloth, however, were heavy and not suited for most consumer merchandise.

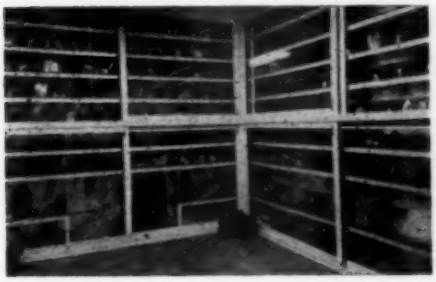
Just before the recent war started, an American scientist — B. H. Foster, of the U. S. Rubber Company's research laboratory at Passaic, N. J. — perfected an entirely new method of weaving cloth from the magic stone, asbestos. In this method, the short asbestos fibers are spun into yarns fine enough to be woven into lightweight fabrics for clothing and for household use. This asbestos cloth is quite strong; has excellent resistance to abrasion; and dyes with unusual brightness. It is suitable for a wide range of uses. Sometimes, to get special effects, glass fiber is mixed with the asbestos fiber.

During the war, the government more or less took over the new process and turned out as much as 1,000,000 yards of this new lightweight cloth a year. It was used mainly for making fireproof fire-fighting suits for the Armed Forces, and enough suits were manufactured to equip the equivalent of five full divisions. These suits weigh only 13 pounds — about one-half as much as the old-time asbestos fire-fighting suits. These suits saved countless lives and property on ships, aircraft carriers, at landing fields, and wherever fires started and had to be fought. It is now planned to make awning, upholstery, and drapery fabrics for use in night clubs, hotels, trains and buses out of the lightweight asbestos cloth. Many fires will be prevented in this way.

Thus, in the brief span of a half-century, this mineral with the unique properties has protected homes and industry from fires, saved many lives, and even created several entirely new industries. That's a really remarkable record for a single stone!

WHAT ABOUT JADE?

Many hundreds of cutters have purchased jade, particularly Wyoming jade, only to find that it was full of specks, would undercut, and exhibit the "orange peel" effect. The so called "apple green" variety that sells for about $6.00 to $10.00 per pound in the words of a renowned jade expert "is so much junk." It is full of specks, has a yellowish tinge that gives it an unwholesome appearance, and will not cut well. Just lately there has been established a firm in Colorado Springs, Colorado, that will handle *good jade* exclusively at prices that the average cutter can afford to meet. The firm is King Gems, Inc. Owned by Richard Charles King, veteran mining engineer, the firm is currently developing a deposit of what may prove to be jadeite. Samples of King jade have been sent to our office and we think it is a beautiful gem stone. Coupled with a mirror like finish, the stone has a color unequaled. We want all of our readers who cut stones to obtain some of this material and have the pleasure of working a really beautiful gem stone.



RUBBER BONDED WHEELS

Sanding gem materials can be greatly facilitated by the use of rubber bonded abrasive wheels. These wheels are a hard rubber that is impregnated with silicon carbide. They are available in 60, 80, 100, 120, 180, 220, and FFF, grits. The advantages of these wheels over the ordinary sanding methods are many. They throw no dust or grit. They can be used to sand corners with ease. Sapphire and other hard gem materials can be sanded many times faster on the rubber bonded wheel. The wheels may also be used to finish silver rings and other items of cast jewelry. Traces of soldering can be removed in seconds. Rubber bonded wheels are currently available from: The Multicraft Shop, 1001 Englewood Avenue, St. Paul, Minnesota.

FAMOUS LOST MINES

— A Series —

Victor Shaw

(3)

LOST PORTAL GOLD

This third story in our series about lost mines concerns a discovery of placer gold in a mountain-walled stream, where big nuggets were picked up by handfuls. It sounds like some splendid though fantastic dream; especially, when due to a succession of grim events, this deposit too slipped into the fascinating category of lost mines.

As the narrative goes, it was the summer of 1864 when the discovery was made, although everyone in the Southwest knows that the summers are far too hot for any such expedition. However, like Uncle Sugar's mails, neither heat, snow, floods, nor zero cold stops a gold-mad prospector. At any rate, it was midsummer when an Indian guided a party of twenty whitemen through a narrow canyon gateway in towering cliffs, into a pleasant green mountain basin that held one of the richest placer streams in mining history. When they saw it they went crazy, for they knew raw gold; but that let them out, for not one of them had ever prospected, or knew anything about mining placer gold. They hadn't enough goldpans, but anyone can paw nuggets out of gravel, and when they got going you can imagine how the sand and water flew.

Now the location of this stream, often called the "Lost Adams", for the leader of the party, is thought to be in some of the desert mountains in the southern part of McKinley County, N. M., and maybe some sixty or seventy miles almost due east from Gallup. This is all desert country, and owing to the scarcity of water still is mostly uninhabited; just a vast maze of naked rocky peaks, high granite mesas, and a labyrinthine network of canyon, gulch, and ravine, most of them scorched and dry. The only water is in a few scattered "tanks", with some short creeks whose water is swallowed by crowding thirsty sands. Here the party found untold riches. Only three lived to tell of it.

THE LEADER of these gold hunters, James Adams, was a husky six-foot Arizona freighter, at this time about thirty-four years old, and said to have been a confirmed devotee of old John Barlycorn. Jim had been hauling freight with his twelve-horse rig from Tucson west to Los Angeles, California. On this eventful summer day, he was hauling west and had arrived in late afternoon at Gila Crossing, in the great bend of the Gila River midway between Mariposa and Painted Rock Mts.

Jim had as usual been drinking, and after turning his teams loose to graze and getting some supper, he finished his jag. There were plenty of hostile Indians around, but doubtless he was too drunk to take any precautions. Anyway, some time during the night the Apaches stole all his horses. He awoke late, to find himself stranded and afoot, and while boiling some coffee, wondering what his next move would be, some friendly Pimas rode up and he secured their help to hunt his teams.

After a long chase and a running fight, he got all twelve of his horses and two riding ponies in addition. Cheerful but weary, he and the Pimas hazed the herd back to Gila Crossing camp, only to find that his

freight wagon and everything in it had been burned up during his absence. No doubt by some of the same band of Apache thieves. So he and the Pimas started for their encampment, for food and where Jim now owing for his freight could do some low-and-lofty figuring.

On the way they came upon a party of whitemen camped near a branch of the Gila, who were excitedly grouped around one of their members who had panned a little gold from the creek sands. Adams and the Pimas halted to watch the fellow wash another panful, which yielded a fair string of flour gold. At which, one of Jim's Pimas grinned scornfully, remarking that if the whitemen wanted that stuff, he could show them a place where they could get a wagonload of it in one day.

The panner laughed at this, but Adams needed some quick cash and began to question the young Indian; who said his tongue wasn't forked, that he had been to the place and seen much gold in lumps as large as wild turkey eggs. When Adams asked how to get to this place, all of the campers crowded around, while the Pima told them it was in a land where it never rained and far away, maybe fifteen sleeps. Pressed to reveal its location, the young Indian said he couldn't say how to get there but he would lead them to it for three horses in payment.

By this time the campers were much excited, and seeing Adams had plenty of horses, they begged him to take the Indian up and they'd agree to pay for the horse stock when they got the gold. But, still a bit cagey, Jim told the Pima: "You show whitemen that place. G o l d there like you say, I give three horse. If no gold I shoot you, keep my horse. You like?" The Pima nodded calmly and the deal was fixed.

IT PROVED a long tough trek, as their Indian guide had said. Day after long hot day they rode up along the Gila stopping at chance villages for such supplies as were needed, always headed to the east-by-north into a wilderness unsettled save for a few roving bands of Indians and an isolated army fort or two. But, Adams and the rest ignored the hardships, cursing heat, flies, and slim rations with goodnatured indifference. In the end, they'd have more gold than they could pack. Hadn't the Pima agreed to be killed, if those big nuggets weren't where he said? Sure, a n d they'd stand anything to get them.

But the way grew rougher, brush and timber thicker and they were steadily climbing ridge after ridge, only to find one rising higher beyond. At long last they topped out on the summit of the Continental Divide, where they saw desert plains stretching eastward and ahead were rolling ranks of jagged peaks, a smoky blue in the distance. They rode toward them circling steep cliffs and down through a forest canyon into the foothills, and finally came to a quiet river with its banks lined by thickets of willow and age-old cottonwoods.

Here the Indian warned them to fill every canteen and water bag, for soon they would reach a dry country with no water at all, the land where there was no rain. Camping but one night, they pushed on through endless rolling sagebrush plains heading for a lofty blue range, which as they rode closer took on shape, color, and detail. Once they crossed a sandy wagon r o a d that looked much travelled. The Pima warned them to remember this road.

"Road go whiteman fort", he told them, but failed to say which way, as some were to recall much later.

Then one day the long strung-out column of riders plodded along the base of some beetling cliffs. Adams rode behind the Pima in the lead, when suddenly the Indian seemed to vanish into the solid wall of cliffs, but presently Adams also rounded a jutting abutment into a narrow canyon portal, where the Indian waited. "'Sta el puerta," (it is the door), he smiled, pointing into the canyon. "Mucho oro aya."

Adams heard the creek foaming over its rocky bed far below, saw it cascading down an outer slope to plunge in a white ribbon into a black gorge far below, from which came a muffled roar.

The canyon they entered took a winding course upward, gloomy and forbidding, a mere cleft in towering black rocks that dripped with moisture that never dried. Their path was just a game trail twisting steeply up around rocky ribs and shoulders, until at last the high walls began to separate out on both sides to enclose an upland valley floored with brush, trees and grass of refreshing green, through which the stream wound more quietly with sand bars, short rapids, and wide pools.

Clumps of pine hid the far end, a mile or so away, but the entire mountain basin seemed to be walled in to form a box canyon, that struck him instantly as a perfect trap. Nor was his sense of un-ease lessened, when the Pima calmly told him that whitemen never came here, just Indians. They were here now, but they were friendly. And Adams sincerely hoped his guide knew what he was talking about, for the encircling walls looked unscalable and the only way out was by the steep game trail through the dark gorge behind.

They had emerged from it well up the sloping basin flank. Ahead the game path sloped steeply down to the stream; and here the whole party for a moment sat relaxed in their saddles and stared eagerly at the stream below for that this was journey's end was apparent. Jim Adams sized them up rather dubiously now.

Most of them were young ranchers, cattle hands, or freighters like himself, between the ages of 25 and 35, and didn't know how the majority would act under fire. In fact, he didn't know their names, as he asserted long afterward, for they flocked by themselves mostly. The only ones he could name were the quiet Peters, lanky Davidson about his own age, the powerful smiling John Wingate, and of course the loud and over-bearing German they all called "Dutchy". Not a bunch to depend on, except for these three older men he knew best.

THE INDIAN led them down to the bank of the stream, where he pulled up his pony and sat calmly relaxed. Adams faced him, eagerly.

"Where that gold?" he asked. The Pima pointed to the creek.

"You look water," he smiled; at which, all hastily slid from their saddles, shoved through brush and willows and peered into it. Sure enough, through the clear mountain water they saw the gravel and sand was dotted with shining sand-scoured lumps of yellow metal. The creek bottom was covered with nuggets, big and little, and their chorus of greedy exultation echoed back and forth among the cliffs.

"Tam vools!" growled the surly Dutchman. "You pring dem savage mit, und dey vill all hair vrom our hets take already."

But nobody heeded, or even heard. Every man was grabbing nuggets and filling pockets, canteens, water bags, hats, anything at all that would hold this wonderful store of untold riches. Nor did they stop until night came and they couldn't see.

A meal was cooked and eaten by firelight, then fires were kindled along the stream and they panned and pawed nuggets from the gravel all night long.

Meanwhile, the Pima grew more restless and anxious to settle up and get going. So Jim Adams called a meeting, of Wingate, Davidson, Peters, and as many others as would come; and, satisfied beyond their wildest dreams, they picked the three best saddle horses, threw in a saddle, rifle and cartridges, and the Indian left before dawn.

That forenoon, while most of the party again were panning, a large band of mounted Indians suddenly appeared from the upper end of the valley, led by a tall stalwart Chief. Everyone ceased work, to eye the approaching riders in dubious apprehension. But they were not in war paint and didn't seem hostile; moreover, when they halted nearby, their Chief rode closer hand lifted in the age-old peace sign.

Adams met him warily, narrowly watched by all his party; but after the usual lengthy palaver with the chief talking broken but comprehensible English, the chief said the whitemen were permitted to gather all the yellow stones they wanted, but they were forbidden to ever go into the upper valley where his people were camped. Smiling his relief, Adams said his men would stay where they were, gave him a big silver watch that didn't keep very good time anyway, and the Indians vanished as suddenly and silently as they had come.

Fear removed, the party began feverishly panning again, and as they hadn't enough pans to go around, Adams set some at building up a proper camp. With timber handy, they planned a log cabin big enough for the whole party, with a fireplace of rough-laid boulders. And at a meeting that night, it was voted to dig a pit before the fireplace in which all the gold was to be dumped and divided equally when they left.. It would be covered with a big slab of slate, as there was plenty around.

To this they all agreed except "Dutchy", who kept by himself mostly, and who said he'd keep all gold he got. All he wanted was to have about $10,000 to go back to Germany, then he'd leave; so, as none liked him, they told him to do as he pleased. The cabin went up swiftly, the pit was dug and lined with slate slabs and a heavy cover

found, into which all dumped the gold gathered each day.

But food supplies soon ran low. There were deer around for meat, but flour, bacon and beans were badly needed; so Adams asked Wingate to lead a party to Fort Wingate for supplies. Wingate picked the man, Peters, and four others including "Dutchy", who had his gold and wanted to get away from there while he still had all his hair. Everybody was glad to get rid of him, and the party left at dawn next morning.

MEANWHILE the rest worked every day from dawn to dark, while the cache in the pit grew until Adams estimated there must be at least five thousand ounces, or about $100,000. He knew some of the men were hiding out their biggest nuggets, but with plenty in the cache he just let it go. In fact, he hid one prize nugget under a boulder, himself. Some of them took turns hunting deer and quail, to help out the slender food supply, but all hoped the grub party would return soon as it had been gone now for over a week.

Besides, several men lately suggested that as all of the big nuggets were picked up much larger ones were farther up the creek; but Adams sternly vetoed anyone going and pointed out that their safety depended on not angering the Indians up there, and that probably the chief had posted scouts to watch every move his gold hunters made. But, some of the younger dare devils scoffed at this and a few of them went up at night, found many big nuggets and thus drew others to follow.

Adams was getting more worried about Wingate's delayed return, and one day when only a few men including Davidson were near the cabin, he put the hunter on guard at the camp and went with Davidson to see if they could sight the grub party coming. They rode fast back through the narrow canyon and out of its portal, and not far beyond it found a horse carcass and the bodies of five men. Indian work, for all had been scalped, but Wingate was not among them. Scattered beans and flour showed they'd been returning and had been recently been waylaid.

Hastily covering the dead with slide and rocks, Adams and his companion rode cautiously back toward camp, now sure that the Indians were aroused and on the war path. Halfway through the canyon this was confirmed by a rattle of gunfire and shrill yelps of Indians coming faintly from the valley beyond. Swiftly gaining the canyon head, they crawled behind sheltering boulders to a point where camp was in view; to find the cabin burning fiercely, and swarms of howling savages running everywhere brandishing the scalps of their victims.

It was the end and noting some Indians heading toward the canyon, Adams and Davidson crawled higher into the cliffs to keep an eye on the raiders, but planning to escape when it grew dark enough. And at the same time—when much later his story and Adams were checked—John Wingate surveyed the scene from another shelter in the cliffs, thought he was the sole survivor and also planned to escape at nightfall. Wingate had been lucky in getting away when his party was attacked, had been slightly wounded but had bandaged his torn leg muscle, thinking at the time it was of little consequence.

Toward evening, when for hours the Indians had left, Adams and Davidson stole down to the creek for water badly needed. Then, under cover of night stole over to the smouldering ashes of the cabin and raked the embers from the thick slate slab covering the treasure pit. But, it was too hot to handle and they waited for it to cool.

Wingate didn't move until dark, then stole to the creek to drink and bathe his injured leg. He saw two shadowy shapes at the cabin site, thought they were Indian scouts, and stealthily made his way down through the canyon portal and fled from that scene of horror. The other two survivors followed an hour or so later, for the pit cover remained too hot, although Adams found his big nugget and brought it out.

Afterward they told how they ate pinon nuts and acorns, how during a lucky heavy shower they caught water in their hats; until two weeks later, ragged and weary, boot soles gone and feet cut and bleeding, they came to a wagon road they thought was the same they'd crossed when going to the gold stream. They didn't know which way the fort lay, but limped on the way they were headed and before long met a small detachment of cavalry with pack mules, to whom they told their tale.

The lieutenant in command was sympathetic, but when asked to get a strong force and capture the Indians who had wiped out their entire party, shook his head. He admitted he'd like to go after the band, but Adams and his companion didn't know just where that valley was located; besides, they were on scout duty from Fort Apache, down on the White River in Arizona and had to report at once. But, he offered to take them both in, and the exhausted survivors were glad to accept.

Davidson is said to have later gone to Fort Whipple, where he had friends, but there his history ends. But Adams, as soon as he recovered at Fort Apache, began drinking and telling his tale to everyone who would listen. Many were excited by the nugget he showed, but he had no luck financing an expedition to get the pit treasure, until he met an ex-captain of the army, who gathered fourteen men and a pack train and started with Adams as guide. But the Apaches were out on the warpath and after several brushes and losing men, they gave up and returned. Some time later, at San Bernardino, California, Adams organized an expedition of his own to find the valley and burned cabin; but, although he went to where he recognized former landmarks, he failed utterly to locate the cliff portal and had to admit his defeat.

Then about 1880, several attempts were made by the army surgeon, who had treated Adams and Davidson at Fort Apache, where he saw and was much excited by the big nugget Adams showed him. He could not get leave then, but after his service period expired, he got a party to start in late fall. This outfit got snowed-in in the mountains, and were forced to abandon the search. He is reported to have outfitted two men to make the search, who actually located the valley and although the leader recognized the burned cabin site, he said nothing planning to return later on—alone. However, before he could outfit, he contracted glaucoma, which settled his chances.

And Wingate's story is similar, although he delayed his search believ-

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DO OUR ADVERTISERS GET RESULTS?

The following are letters and exerpts from letters that advertisers have sent us commenting upon the response they got from their ads in E. S. D. These letters are unsolicited.

Gentlemen:

Just a line to say how pleased I was with the response I had to the small classified ad I ran in your magazine. I am going on a trip in May for a couple of months to Montana and a few other states that offer fertile gem collecting locales. Before I return I will send you another ad. You may count on my ad all next winter.

Yours very sincerely,
Al Thrower,
Santa Cruz, California.

Earth Science Digest,

Your magazine is excellent. Am well pleased with classified ad results.

Frank Lyman,
Lantana, Florida.

Dear Mr. Berry:

We are definitely getting results from our advertisement in your publication. In fact I may safely say that we are getting more results from our ad in your magazine than all others combined.

Robert Menser,
Northwest Gem Shop,
Tacoma, Washington.

Gentlemen:

E. S. D. definitely produces results. Received inquiries from my ad in August issue as late as last December!

Howard Harrell,
Omaha, Nebraska.

Gentlemen:

Enclosed is $2.00. Please renew my classified ad. Orders are coming in from it from Mass. to California. It's a humdinger little magazine and I wish you every success. Collectors of rocks, crystals, and fossils are already driving in here from many states and I am kept busy guiding them out into our Ozark hills to the various deposits.

Yours Truly,

John Jennings,
Eureka Springs, Ark.

These letters are just a few of many. We want to thank the readers of the Digest for the support they have given our advertisers, and the advertisers in turn for the support they have given E. S. D.

COMING SOON

So much interest has been exhibited by our readers in gems, gemology, and lapidary subjects that we have decided to run a lapidary section in the Digest. This section will be edited by Richard M. Pearl of Colorado College. Mr. Pearl is coauthor of "The Art of Gem Cutting" and author of "Mineral Collectors Handbook" which will be published in October.

Notes On Stratigraphy Of The Carboniferous Of Scotland

Harrell L. Strimple

While in service with the U. S. Army in Scotland, it was my good fortune to be billeted just off Great Western Road near the Botanical Gardens and only a short walk from the famous University of Glasgow. When the opportunity arose I went to the University, primarily to see the Hunterian Museum which is housed in a wing of the Geology Building. Inquiry of the custodian disclosed that Dr. Currie was ill at the time, however, her assistant was most kind and showed me the excellent collections of echinoderms and trilobites which were not on display. Some time later, when in search of some reference books, I had occasion to meet Dr. Currie, a charming and pleasant lady.

The geological portion of the Hunterian is designed to serve students of the University. In the paleontological section display of type faunas for the main eras, as well as displays with biological emphasis were given. The mineralogy section included actual display specimens and crystallographic models. I took a few notes on the Carboniferous Period (American Mississippian and Pennsylvanian), which are given herein.

It will be noted that faunal zones are used with emphasis on cephalopods and pelecypods (lamellibranchs), "letter" designations apparently taken from the first letter of the generic name. One chart uses Continental terms in the major divisions, such as Visean, etc. Individual zones are designated by subnumbers under the "letter" major zones, for example, the famous crinoid beds of Coplow Knoll, near Clitheroe, England, is "C^1", the main crinoid beds of Scotland are in "D^1, D^2" which are all in the Lower Carboniferous. The Scottish crinoid zones worked by James Wright are in the Lower Limestone Group which is considered by many as being the equivalent of our American "Chester Group" — upper Mississippian (Lower Carboniferous).

Before I left Glasgow, Prof. Trueman, head of the Geology Dept., returned from a business trip to South Africa. Mr. James Begg provided an introduction and Prof. Trueman entertained us with stories of experiences from his trip. We had a "spot of tea" with the staff—all most pleasant.

As previously mentioned the Hunterian Museum serves the University, also several staff members of the Geological Dept. are active in the Geological Society of Glasgow. Mr. Begg invited me to accompany him to one of the business meetings of the society. A very capable group of people were present and the business progressed rapidly. The society was in search of a new permanent residence. There was also a strong discussion on the problem of making the lectures of the open meetings along lines that would appeal to the general public and particularily to interested amateurs. Apparently the science of Geology is suffering from loss of public interest through technical "dryness" in Britain as it is in America. If it were not for the La Brea asphalt pits, and the dinosaurs, geology would be a "forgotten" science in America.

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CLASSIFICATION OF SCOTTISH CARBONIFEROUS ROCKS

Upper Carb.	Upper Barren Red Coal Measures		Red ss. with very little coal
	Productive Coal Measures		Skipsey's Marine Band Ss. and sh. with coal seams Slatyband Ls.
	Millstone Grit		Thick white ss. and fireclay
Lower Carb.	Carboniferous Limestone Series	Upper Limestone Group	Castlecary ls. Arden ls. Orchard ls. Lyoncross ls. Index ls.
		Limestone Coal Group	Possil Garscadden
		Lower Limestone Group	Hoxie ls. Blackhall ls. Neilson shell bed Hurlet ls.
	Calcareous Sandstone Series	*West of Scotland* Upper Sedimentary Group incl. Hollybush and Blackbyre ls. Volcanic Series Cementstone Group	*East of Scotland* Oil shales Series Massive ss. Cementstone Group (incl. volcanic episode)

	Goniatites Zone		*Lamellibranch Zones*
Upper Westphalian		Upper Coal Measures	Anthracomya tenuis Anthracomya phillipsi
Lower Westphalian	A.—Anthracoceras G.—Gastrioceras	Middle & Lower Coal Measures (Productive Coal Measures in Scotland)	Anthracomya pulchra Carbonicola similis Anthracomya modiolaris Carbonicola ovalis
Namurian	R.—Reticuloceras H.—Homoceras E.—Eumorphoceras	Millstone grit	
Tournaisian & Visean	P.—Goniatites D.^{3}—Prolecanites S. C. Z. K.	Floral break Lower Carboniferous	

Most complete section of Lower Carboniferous in Britain is Avon Gorge near Bristol, England.

Visean	Dibunophyllum Zone - D. 1, 2, 3.	Lower limits defined by entrance of Dibunophyllum
	Seminula Zone - S. 1 & 2.	Lower limits defined by entrance of Lithostrotion
Avonian	Syringothyris Zone - C. (1 & 2)	Entrance of Caninia or other large caninid (*C. patula*)
	Zaphrentis Zone - Z. (1 & 2)	Entrance of Zaphrentis and maximum of *Z. delanouei*
Tournaisian	Cleistopora Zone - K. (1 & 2)	

Oklahoma Meeting

On Sunday, June 8th, the Oklahoma Mineral & Gem Society celebrated its first anniversary. The Oklahoma City members unrolled the "Welcome Mat" to the out of town and out of state members. The day was spent in viewing the many collections and in exchanging ideas and experiences, and in rock talk in general.

All members assembled at the H. T. Daniels residence and then made the rounds of the other club member's homes. A picnic lunch was served at the O. C. Bundy home and then more collections were viewed. Ice cream and cake were served at the J. B. Lankford home before the members departed for their homes in the evening.

Out of town members and guests were: Mrs. Perry and Mr. Osborne of Perrys Rock Shop, Poncha Springs, Colorado. Miss Blanche Harding; Mr. and Mrs. Herman Klingler; and Mrs. Jantz and son Harry, all of Custer City, Oklahoma. Bill Swearingen of Blackwell, Oklahoma.

The Society was honored to have as their guest for the day Dr. Robert H. Dott, Director of the Oklahoma Geological Survey, Norman, Oklahoma.

The Oklahoma Mineral and Gem Society was organized on June 6th, 1946 with seventeen Charter Members. It is now one year old and boasts forty six members.

COVER PHOTO

This month's cover photo is an air view of "Chimney Rock" in western Nebraska. This rock is a grotesque remnant of erosion that towers above the surrounding countryside.

ARTIFICIAL EROSION AGENT —SHELL BURSTS

The agents of erosion which are discussed in the usual textbook of geology include the work of man, but the reader does not find much mention of one which was practiced several years past—erosive destruction of war. In the accompanying photograph is seen a view of an Italian farmer's hayfield, in the Gothic line, which has undergone some erosion by exploding shells. Mines were buried along the highway which skirts the top of the hill. Possibly unexploded mines and shells remain in the field to cause more erosion and probable fatality some time hence if one is set off by a person or animal working or moving in the hay "meadow". War is hell! Tensely so, long lasting, and completely destructive in its consequences. So called "civilized" man had better show his civilization by making a success of forestalling another armed conflict. Erosion caused by man had better be in a constructive pursuit than the example shown here.

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America is making progress toward cultural development. Europeans have long recognized the pleasures and better living associated with the Arts and Sciences.

Our Most Indispensable Minerals

W. D. Keller

What mineral or family of minerals is the most indispensable, or the most fundamental to the life of man and civilization on this globe? Try this one on yourself. The usual answers to that question by persons who reply too quickly are coal, iron ore, radioactive minerals (in this atomic age) petroleum, or occasionally copper or gold (forgetting that it is old fashioned now to be on the gold standard). However, after a little sober reflection on what mineral substances are really necessary to maintain life, the first quick answer is usually revised along the following lines of thought.

Man did exist before even the bronze age and the iron age, and he could get along again at the present time, if he had to, without many of the metals so widely used in our daily conveniences. Truly, we learned that fact during the war, when we were forced to use ersatz materials and to do without others, but we managed to get along. But the one absolute necessity is food, and next to that come clothes and fuel. Lets see how we translate these absolute needs into minerals.

The beefsteak we enjoy so much can be traced back through many ears of corn, or cuds of grass and hay, all of which grew on the land—that is, on soil minerals. Both cotton and wool clothing have a plant ancestory which grew on a mineral foundation. Even nylon, and beautiful dyes and tasty flavors which are products of coal and coal tar, trace their family tree back to the trees or tree-like ferns which grew in the swamp and gave rise to the coal bed. All major plants in Nature require one group of minerals to make normal growth in soil (skipping hydroponics), and that group is the clay mineral family—the most indispensable minerals for man today. So the tiny, elusive, versatile, usually non-spectacular clays take the blue ribbon.

Perhaps we should meet the members of the clay family before exploring their uses further. Kaolinite whose formula is $H_4Al_2Si_2O_9$ (theoretically, 46.5 per cent silica, 39.5 per cent aluminum, and 14 per cent water) is the commonly known one but it is not the most common in occurence everywhere. Kaolinite forms under deep or profound surface leaching, especially where the ground water solutions are oxidizing or a little bit acid. In the Appalachians kaolinite occurs as the white or nearly white clays over weathered pegmatites, or as subsequently transported deposits. Both of these kaolins are common sources for mineral collections and for clays used in making fine china ware. The red and yellow clays in our southern soils are also mainly kaolinite which has been stained by hematite and limonite.

Dickite is another member of the kaolin group which should be the more highly prized by most collectors because it commonly occurs in beautiful, but very tiny hexagonal-shaped crystal flakes. Dickite has the same chemical composition as kaolinite but it has a slightly different atomic arrangement.

Another decidedly different group of clay minerals is the montmorillonite characterized chemically by being higher in silica than kaolinite, and by containing notable amounts of magnesium, calcium, iron, and alkalies. The behavior of the magnesium, calcium, sodium, and potas-

sium is particularly interesting because certain amounts of those metallic elements (commonly about 80 milli-equivalents per 100 grams of clay) are exchangeable. That is, potassium which is a part of the clay may be substituted by calcium, magnesium, sodium, or even by hydrogen, whereupon the replaced element is freed to go away in solution or to a plant root. Any excess of one of the above elements will displace some of the others then held by the clay. Because of this characteristic, montmorillonite clay is said to possess strong base exchange properties. In contrast, kaolinite is a more stable mineral and has quite low base exchange capacity.

Base exchange is extremely fundamental in plant nutrition. Soil scientists have learned that plants characteristically extract their mineral nutrients from clay colloids or organic compounds which exhibit base exchanges. For instance, an alfalfa or bean plant sends its roots down into colloidal clay and takes up calcium which has been loosely held by the clay, and gives hydrogen in return for the calcium. Repeated operations of this sort produce an acid or hydrogen clay and an acid soil. The wise farmer then adds crushed limestone, $CaCO^3$, to the acid soil, and the acid clay now grabs some of the calcium, Ca, and returns to its previous condition. If potash fertilizer is added, potassium will be absorbed by the clay which acts as a "jobber" to supply the next plant rootlet in search of potassium. By selective feeding, the plant roots may search out calcium, potassium, magnesium, or other nutrient-bearing clay colloids and make a luxuriant growth having high nutritive value.

On the other hand, without adequate mineral elements in the soil, the plant growth is mainly a carbohydrate, not protein, and its food value to animals or man is sadly deficient. An animal, including man, will suffer serious food deficiencies and malnutrition by trying to subsist on plants grown on mineral deficient soils. Animals are known to select hay or grass which have been grown on a soil of balanced fertility in preference to adjacent food supply grown on deficient soil. Man does not have this food sense and therefore usually picks out plump, well colored vegetables or fruit which attract his eye and fill his stomach, but may leave his tissues, bone and glands starving to death. This is an extremely serious relationship that we in the United States need to heed.

We have inherited soils which were rich in adequate plant nutrients, but because we have not returned the mineral substances we have been "mining" our soils. As a result of this practice, in some localities, particularly in certain soils of the south, serious nutrition deficiencies have shown up as medical and veterinary cases, and in other regions stock men are adding mineral supplements to animal feeds. The time has already arrived, and it will become increasingly acute in the future, when we will have to add to our soils almost pound for pound of mineral matter that we haul off to the cities in the form of foods, textiles, and lumber. The only other source of plant nutrients is the weathering rock below the subsoil, but that takes place too slowly to replace the rapid extraction by plants. European and other nations

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know the seriousness of soil depletion. We have a national and strategic problem before us in the replacement of mineral fertilizers to our soils.

The preceding harangue about soil fertility is not a distant digression from clay minerals. Remember that the clay mineral colloid is the go-between or intermediary between the coarser unweathered mineral (plant food) particle and the plant, and that montmorillonite clays are the most effective intermediaries because of their high base exchange capacities. Hence, man's nutrition depends a lot on the clays in his nation.

Montmorillonite forms where weathering and leaching are not too profound, and where magnesium and other metallic elements are plentiful in ground water. Abundant organic matter lingering in the soil and maintaining a reducing action conduces toward montmorillonite rather than toward kaolinite. These conditions of weathering exist in the bands across the globe where temperate climate prevails, and consequently clay minerals of the montmorillonite group are the dominant (but not sole) clay minerals of the soils in the temperate regions.

The occurrence of montmorillonite clay and productive soils of nutritious food has important sociological significance. The most aggressive nations, and the farthest advance in civilization (discounting the utter folly of war in which they also lead) are located in the belts across the globe where montmorillonite soil clays produce foods which generate virility. Temperate climate is to be correlated with the kind of soil clays as well as with thermometry. Kaolinitic and lateritic (bauxitic) clays are more likely developed in the tropics; those clays have low base exchange values and therefore plants of the carbohydrate and cellulose varieties—not virile, protein and mineral-rich varieties—thrive in the tropics. The allegedly lazy habits of persons living in the tropics are due in part to the type of food produced there.

There are therefore, sound scientific reasons why our strong American nation is in the U. S. A. Let us keep our soils built up, let us maintain our strength, and let us not discredit the rich inheritance which came to us from the geological past.

Still another group of clay minerals, known variously as the illite (named from Illinois, whose scientists admirably described the group), the bravaisite, or the mica-like clay group is abundant in some shales and surface clays. In this group potassium is characteristically present but it is held more tightly than that which is absorbed in base exchange by the montmorillonite group.

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MINERAL QUIZ

Jerome M. Eisenberg

Name the localities for which these associations of minerals are famous:

1. Franklinite, willemite, zincite.
2. Cryolite, siderite, galena.
3. Rutile, lazulite, kyanite.
4. Apophyllite, amethyst, calcite.
5. Sulfur, celestite, gypsum.
6. Cancrinite, nephelite, sodalite.
7. Copper, prehnite, datolite.
8. Millerite, calcite, dolomite.
9. Livingstonite, cinnabar, stibnite.
10. Cryophyllite, lepidomelane, danalite.

ANSWERS TO MINERAL QUIZ: 1) Franklin Furnace, New Jersey. 2) Ivigtut, Greenland. 3) Graves Mt., Lincoln Co., Georgia. 4) Guanajuato, Mexico. 5) Sicily. 6) Litchfield, Maine and Bancroft, Ontario, Canada. 7) Lake Superior District, Keweenaw Peninsula, Michigan. 8) Keokuk, Iowa; also St. Louis, Missouri and Milwaukee, Wisconsin. 9) Huitzuco, Guerrero, Mexico. 10) Rockport, Massachusetts.

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paint, paper, and rubber. Certain clays will catalyze chemical reactions, others are absorbents and filters, and some have cleansing or detergent properties. Many tons of shale and clay go into the manufacture of Portland cement.

Fire clay and fire brick are some of the most basic of all earth materials because fire brick is the high temperature resistant lining for the "kettle" which holds the basic metals when they are refined and melted. Without fire clay we could have advanced but little in our "age of the metals".

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Besides the vital role of clays in soils, we use them for making building brick and tile, for cosmetic and medicinal purposes, and as fillers in

What is the most indispensable family of minerals? Without doubt it is the humble family of clay minerals.

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ing himself the sole survivor and thus having plenty of time. He had a terrible trip after leaving the valley, but was finally rescued by friendly Indians and when recovered was set on the road to the Rio Grande River and made it to Santa Fe, N. M. Some years later, he made several attempts to locate the narrow canyon portal, but his experience while escaping made him forget many vital details, so he too failed.

In the more than half century since all this happened, many others have tried and failed to find that legendary lost portal, which is the only entrance to the valley of golden sands and the treasure in the burned cabin pit. But today modern scientific progress has perfected better and more positive methods of discovery. For example, there is the geophysical instrument called a magnetometer, also the new Bell Aircraft helicopter to use the instrument from the air. And, just the other day, this outfit was proved highly efficient in discovering new mineral deposits in both the United States and Canada while flying and hovering as low as a hundred feet above the ground.

So, how about flying this outfit over all the desert mountains in southern and central McKinley County, N. M. . . . .?

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Poly Saw Mandrel, 5/8"	8.25
Poly Saw Mandrel, 3/4"	9.25
Sartwell Gem Drill	29.50
Knapsacks for your rock trips	1.00

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